$$\mathrm{J} = \frac{\mathrm{kg{\cdot}m^2}}{\mathrm{s^2}} = \mathrm{N{\cdot}m} = \mathrm{Pa{\cdot}m^3} = \mathrm{W{\cdot}s} \qquad 1\ \mathrm{Pa} = 1\ \frac{\mathrm{N}}{\mathrm{m^2}} = 1\ \frac{\mathrm{kg}}{\mathrm{m{\cdot}s^2}} = 1\ \frac{\mathrm{J}}{\mathrm{m^3}} \qquad 1\ \mathrm{N} = 1\ \frac{\mathrm{kg \cdot m}}{\mathrm{s^2}}$$

- $1\ \mathrm{cm^3} = 1\ \mathrm{mL}$; $1000\ \mathrm{mL} = 1\ \mathrm{L}$

$$\textit{Fluid weight}: W = \rho g V$$

1. Gravitational Potential Energy (Ug)

If an object is elevated above the surface of the earth with h, it has a **potential** energy to move vertically towards the surface of the earth.

$$U_g = \pm mgh \quad \text{(J=N.m) or (Ib.ft)}$$

where

m is the mass of the object (kg) or (slug).

g is the gravitational acceleration ($9.81\ m/s^2$) or ($32.2\ ft/s^2$).

h is the vertical distance from a datum.

3. Kinetic Energy (Uk)

It is the energy that generate due to objects motion.

$$U_k = \frac{1}{2}mv^2 \quad \text{(J=N.m) or (Ib.ft)}$$

where

m is the mass of the object (kg) or (slug).

v is the object velocity (m/s) or (ft/s).

2. Elastic Energy (Ue)

$$U_e = \frac{1}{2}ks^2 \quad \text{(J=N.m) or (Ib.ft)}$$

where

k is the spring constant (or stiffness) (N/m) or (Ib/ft).

s is the stretch or compression in the spring (m) or (ft).

Engineering Stress $= S = \frac{W}{A_0}$

Ratio of stress to strain is modulus of elasticity (Young's Modulus); E, which measures stiffness

$$E = \frac{\sigma}{\varepsilon}$$

Engineering Strain $= e = \frac{\Delta L}{L_0}$

$$\textit{True Stress}\ \sigma = \frac{W}{A} \qquad \textit{True Strain}\ \varepsilon = \ln\left(\frac{L}{L_0}\right)$$

Heat transfer by Conduction

$$Q = \frac{\kappa A \Delta t}{L}(T_\mathrm{h} - T_\mathrm{l})$$